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ABSTRACT

The persistent underrepresentation of women and people of color in science and mathematics education and careers remains a challenge to all who champion the commitment of equity and excellence in education. This is the first publication in a series produced by the Science and Mathematics Education unit at the Northwest Regional Educational Laboratory (NREL) that is intended to furnish K-12 teachers with both research-based rationale and recommendations for effective techniques that can be applied in today's complex and changing classrooms. This publication focuses on equity in the classroom. Topics include good teaching, expectations, welcoming diversity, confronting stereotypes, mathematics and science for everyone, classroom interactions, learning styles, ability grouping/tracking, cooperative learning, hands-on activities, single-sex grouping, the importance of connection, writing, career awareness and role models, mentors, peer mentoring, assessment, family involvement, and professional development. Listed resources include publications, curricula, organizations, online resources, and bibliography. (JRH)

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Science and Mathematics for All Students

It's Just Good Teaching

ED 410 121

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Science and Mathematics for All Students

It's Just Good Teaching

A publication by the Science and Mathematics Education Unit
in cooperation with the Center for National Origin, Race, and Sex Equity

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Northwest Regional Educational Laboratory

Table of Contents

Preface 1

Introduction 3

It's Just Good Teaching 4

- Expectations 5
- Welcoming diversity 5
- Confronting stereotypes 7
- Mathematics and science are for everyone 10
- Classroom interactions 11
- Learning styles 12
- Ability grouping/tracking 13
- Cooperative learning 14
- Hands-on activities 14
- Single-sex grouping 15
- The importance of connection 16
- Writing 17
- Career awareness and role models 18
- Mentors 18
- Peer mentoring 19
- Assessment 19

Family involvement 20

Professional development 20

Conclusion 22

Resources and bibliography 23

- Publications 24
- Curricula 25
- Organizations 25
- Online resources 28
- Bibliography 30

Preface

The persistent underrepresentation of women and people of color in science and mathematics education and careers remains a challenge to all who champion the commitment to equity and excellence in education. The Northwest Regional Educational Laboratory's mission—to improve educational results for children, youth, and adults by providing research and development assistance in delivering equitable, high-quality educational programs—is grounded in these principles of equity and excellence. In addition, in the area of science and mathematics education, the issue of equity prevails as a central tenet in the Laboratory's continuing efforts to provide products and services that contribute to and support effective teaching and learning.

The Science and Mathematics Education unit at the Northwest Regional Educational Laboratory is producing a series of publications intended to furnish K-12 teachers with both research-based rationale and recommendations for effective techniques that can be applied in today's complex and changing classrooms. Translating theory into practice requires not only an understanding of the relevant research but also the ability to adapt the findings to the individual, dynamic contexts of Northwest schools. Subsequent publications will address other essential components necessary for comprehensive and sustained progress in science and mathematics education including: linking curriculum, instruction, and assessment in the classroom; inquiry- and investigation-based teaching; creative time management strategies; and facilitating continuous improvement in a standards-based system.

The intended use and purpose of *Science and Mathematics for All Students* are mirrored in its content and organization. An initial summary of the key themes from current research and literature on the underrepresentation of women and people of color in science and mathematics frames the ensuing discussion of research-recommended practices for achieving equity. Included throughout the publication are Northwest examples of classrooms and programs where these strategies have been implemented and demonstrated success. These highlighted cases demonstrate instances of real-life research in practice to illustrate how some are facilitating and encouraging the participation of girls and students of color in science and mathematics. The listing of current equity-related resources points teachers towards additional tools to explore and utilize in their efforts to provide all students with the mathematics and science knowledge, skills, and abilities necessary for success.

It is not a coincidence that this first publication focuses on equity in the classroom. While efforts to improve the participation of females and people of color in

Underrepresentation of women and people of color in math and science

High school course taking. Despite some progress, inequities persist in high school science and mathematics course taking and achievement scores. African American and Hispanic students are far less likely than White students to take advanced science courses such as chemistry and physics, or advanced mathematics courses such as algebra II, trigonometry, and calculus (Selvin, 1992). African American and Hispanic students continue to score substantially lower than White students on national assessments at all age levels. While female students now take higher-level mathematics classes in almost equal numbers as male students, twice as many males take advanced physics.

College and professional careers. African American, Hispanic, and Native American students earned only 12.5 percent of all bachelor's degrees conferred in science and engineering in 1993. Their participation in graduate science and engineering programs drops even more, with only 9.4 percent participating out of all U.S. citizens enrolled (National Science Foundation, 1996).

Women now earn 45 percent of the bachelor's degrees in science-related fields. However, females are more highly concentrated in social sciences such as psychology and sociology, while earning only one-third of mathematics degrees and 16 percent of engineering degrees. Their participation decreases from here. In 1993, women made up only 36 percent of graduate enrollment in mathematics and science and were awarded only 30 percent of the doctoral degrees in these fields.

The underrepresentation of women and people of color is most pronounced in scientific careers. In the United States, 51 percent of the population and 46 percent of the workforce are women, but they make up only 22 percent of scientists and engineers. In the workforce, people of color comprise a small proportion of scientists and engineers. Though African Americans, Hispanics, and Native Americans make up about 23 percent of the population, they comprise only 6 percent of the total science and engineering labor force (NSF, 1996).

the fields of science and mathematics have resulted in an improved climate and increased opportunities for these populations, we must not become complacent and believe we have "solved" all the equity issues. The call in national and state standards for high expectations and quality learning experiences for all students reminds us to be vigilant and to continue the pursuit. As the title suggests, while the strategies described in this publication are drawn from equity research, it will be obvious to many readers that they reflect practices that are at the core of good teaching and therefore will benefit *all* students rather than only those traditionally filtered out of the science and mathematics pipeline. For further assistance, the Center for National Origin, Race, and Sex Equity can provide training and technical assistance free of charge to public schools in all equity-related areas.

The diversity of Northwest classrooms relies on the creativity and expertise of the individuals who comprise the instructional staff to address a multitude of student needs. The Northwest Regional Educational Laboratory acknowledges your creativity and expertise and offers *Science and Mathematics for All Students: It's Just Good Teaching* as a resource to assist your efforts to strengthen science and mathematics education for all Northwest students.

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Introduction

The demographic landscape of the Northwest is changing. The region's cultural heritage is increasingly diverse. Jobs in timber, fishing, and oil resource development are diminishing while opportunities are increasingly found in the new frontier of advanced technology and information services. Knowledge of mathematics and science is essential to participate in today's society, but a significant number of students leave school seriously underprepared in these areas.

The very people who now comprise the fastest growing percentage of the population and workforce—people of color and women—have historically been underrepresented in mathematics and science. This has been a persistent and pernicious problem for this country, one with profound moral and economic implications.

This is not a new concern in education. For years, educators have been working to achieve equality for all students, and some progress has been made. For example, women now earn more bachelor's degrees in science than ever before, and more students of color are taking college preparatory mathematics courses in high school. Because this issue has received so much attention, it is tempting to believe that educational inequities have been effectively dealt with, yet in fact they persist. These inequities cannot be quickly resolved, but require our continuous attention and effort.

Changing workforce. One of the most well-known arguments for educational equity is economic necessity and demographics. The segments of the population and the workforce which are growing most rapidly are women and people of color. According to the Population Research Bureau, by 2050 the four largest minority groups—African Americans, Hispanics/Latinos, Asian Americans, and Native Americans—will make up nearly half of the population of the United States (Powell, 1994). Women are now 46 percent of the workforce and growing (NSF, 1996).

Minority populations are growing at a slightly faster rate in the Northwest than in the nation as a whole. The proportion of students of color in each state varies widely, with approximately 35 percent in Alaska, 20 percent in Washington, 13 percent in Oregon, 11 percent in Montana, and 10 percent in Idaho. Between 1986 and 1992, public school enrollment of students of color in the Northwest increased by 8.6 percent, compared to the national growth rate of 3 percent (Barnett & Braunger, 1997). In just a few short years, students of color are expected to comprise one-third of our national school population (Tippins & Dana, 1993).

Hispanics are the largest minority group in the Northwest at 5.9 percent of the population, followed by Asians at 4.2 percent, Native Americans (including Alaska Natives) at 4 percent, and African Americans at 3.1 percent (Barnett & Braunger, 1997).

Changing workplace. As the workplace becomes more technologically complex, people need more mathematical and scientific skills than ever before. This is true in all sectors of the economy, not just those careers traditionally associated with mathematics and science. We are now in a race against time to prepare today's students to participate in an increasingly technological world.

Changing society. Beyond the workplace, everyday life and matters of public policy also require more mathematical and scientific knowledge. All members of society need to understand the implications of issues involving medical research, environmental impact, or inflation. The ability to analyze complex issues requires literacy in mathematics and science for all U.S. residents.

Changing education. Recent standards developed by the National Council of Teachers of Mathematics and the National Academy of Sciences are an attempt to better prepare students to meet the demands of the changing workplace and society. Educators in the Northwest are vigorously participating in national education reform by devising standards, curricula, assessments, and teaching strategies to meet the learning needs of all students.

The bottom line—justice. Beyond the arguments of economic necessity and public policy, equity is of fundamental importance because it is a moral issue. In a just society, women and people of color must have an equal opportunity to learn science and mathematics. This knowledge is an essential tool for economic opportunity and safeguarding the rights of everyone (Tate, 1994).

Inequality is not just a condition in education, and teachers alone cannot change the injustice that is pervasive in society. Teachers frequently face many other obstacles as well: overcrowded classrooms, lack of support from administrators and parents, lack of professional development opportunities, and shortage of time. Nevertheless, teachers play an essential role in creating solutions to educational inequities. For example, teachers can model equitable practices to students, parents, and community members. Although inequity is a complex issue with no easy answers, there are many practices that teachers can adopt to increase all students' participation in mathematics and science.

It's just good teaching

For years, experts in multicultural and gender-fair education have promoted a number of teaching strategies which are particularly effective for girls and students of diverse cultural and language backgrounds. Today, we know that several core strategies are effective for all students, including:

- Having high expectations for all students
- Providing a classroom environment that welcomes and involves all students
- Using teaching strategies that respond to the needs of diverse learners

■ Helping students to make connections between new ideas and their personal experiences

Expectations. Research indicates that low expectations for the achievement of females and students of color in mathematics and science have a significant impact on their academic success (Eccles et al., 1983; Shepardson & Pizzini, 1992). These lower expectations are often unconscious, but they affect the way teachers interact with students. For example, researchers have found that teachers tend to call on males more often and give them more time to answer (Brophy, 1985; Eccles & Blumenfeld, 1985; Jones & Wheatley, 1990). Studies have also found that females are asked more routine, low-level cognitive questions, while males are asked more challenging, high-level cognitive questions (Leder, 1990). Teachers are also more likely to comment on the behavior of students of color rather than on their schoolwork (Secada, 1992).

Parents are often more willing to accept their child's underachievement in mathematics and science than they are in other subjects (Tocci & Engelhard, 1991). Because of gender role stereotypes, parents often do not give their daughters as much encouragement in these subjects (Eccles, 1989; Yee & Eccles, 1988). Students internalize these messages and often lower their own expectations, which diminishes their confidence in their abilities and influences their aspirations. For example, in a study of 13-year-old students, Tocci and Engelhard found that parental support was a significant predictor of attitudes toward mathematics. They found that the higher the parental support, the better the students' attitudes toward mathematics (Tocci & Engelhard, 1991). Because they do not expect to achieve, girls and students of color may not try as hard in their mathematics and science classes. As a defense mechanism, they may dismiss these classes as unimportant or irrelevant to their lives (Eccles, 1989).

> Throughout the history of human beings, there have been several pivotal points that thrust us into the next century or millennium.... Multicultural education is the pivotal point in education in the 1990s thrusting us into the 21st century and the second millennium.
>
> —Shelley Johnson Carey, *Science for all Cultures* (1993)

Low expectations can also influence unequal school funding. Poorer schools, whose populations are often predominately students of color, may be expected to operate with less funding, less-qualified teachers, few or no advanced classes in mathematics and science, inadequate equipment and materials, and little money for teachers' professional development (Kozol, 1991; Tate, 1995). High teacher turnover in these schools is common—as much as 33 percent in Native American schools (Allen & Seumptewa, 1993)—which undermines student/teacher relationships and continuity in teaching methodology.

Welcoming diversity. Teachers who are fortunate enough to have students from diverse cultural backgrounds are given a prime opportunity to incorporate students' unique life experiences and learning styles into their instruction, enriching the learning experiences of all students. Even with a homogeneous classroom, there are numerous

things that can—and should—be done to create a classroom that truly values diversity.

James A. Banks, the preeminent scholar in multiculturalism at the University of Washington in Seattle, provides some guidelines that teachers can follow to transform their classrooms into environments where all students have the opportunity to learn critical skills, to experience the pleasure of a rich intellectual life, to develop a more accurate understanding of their world, and to achieve at a higher level. In an interview with *Educational Leadership* (Brandt, 1994) and in the *Handbook of Research on Multicultural Education* (Banks, 1995), Banks identifies three elements for creating a successful multicultural classroom: global education, multicultural education, and equity pedagogy.

Banks explains the difference between global and multicultural education—two major aspects of teaching diversity. Global education emphasizes the cultures of other countries, and multicultural education emphasizes the diverse cultures within students' own country. Both encourage schools to go beyond having students solely participate in well-known cultural holidays and celebrations, for example, Cinco de Mayo and The Rev. Martin Luther King, Jr.'s birthday. To help students truly develop an understanding and respect for the cultural diversity they encounter every day in their own country, teachers must weave meaningful elements of cultures—values, knowledge, world views, history—into their instruction, curricula, and interactions with students.

It is also important to recognize students' different learning needs and to create conditions in the classroom to meet those needs. Research shows that students' cultural milieu greatly influences their learning preferences; people are socialized to learn in various ways. For example, Native Americans may be socialized to learn by listening to elders and relying on their memory rather than taking notes. African American and Hispanic students often learn by talking and interacting with family and community members in small cooperative groups (Barba, 1995).

As a Crow Indian and elementary school teacher at St. Charles School in Pryor, Montana, Jennifer Flatlip is an important role model and mentor to her Native American students.

"I'm a Native American in the classroom. I know my culture. I know my language. I can talk about the values, the spirit world. I can talk about the dances. I can sing the songs and I feel like I'm a great contributor to my students, and they have a real good, positive self-image about themselves as Native Americans," she says.

Flatlip is a lead teacher in Montana's Systemic Teacher Excellence Preparation (STEP) project that matches student teachers with exemplary mathematics and science teachers. One of the project's primary goals is to recruit more Native Americans into mathematics and science teaching, and to provide them with training and early-career support.

STEP is one of three statewide programs in Montana aimed at increasing the participation of Native Americans in mathematics and science. A videotape, *Mathematics and Science for All: Native American Students*, features students and teachers reflecting on their participation in these programs. A corresponding booklet offers suggestions for how others can implement similar programs in their states. (See listing under "Resources.")

Understanding the learning needs of students is especially important when teaching such subjects as physics or algebra where cultural relevancy may not be as apparent as in history or literature. Equity pedagogy occurs when "teachers use techniques and methods that facilitate the academic achievement of students from diverse racial, ethnic, and social-class groups" (Banks, 1995). Banks points to the work of Philip Uri Treisman, professor of mathematics at University of Texas at Austin. While observing students at Berkeley, Treisman noticed that Chinese students were doing well in calculus but African American students weren't. When he saw that the Chinese students supported each other in tutorial study groups, he helped the African American students create small study groups, and found that their academic performance improved as well (Brandt, 1994).

Robertta H. Barba, education professor at University of New Mexico in Albuquerque, and author of *Science in the Multicultural Classroom* (1995), offers these suggestions for creating a classroom that truly values diversity:

- Make sure that small groups have students of mixed abilities and cultures, when possible
- Permit students to use "home languages" in small-group discussions, when appropriate
- Integrate into curricula and materials examples of women and people of color who are mathematics and science professionals; use images that depict them in positions of authority and actively involved in a scientific and mathematical activity
- Acknowledge that many achievements by women and minorities have been obscured throughout history because women and people of color often have been excluded from mainstream professional activities

- Include mathematical and scientific achievements that were made by group endeavor, in addition to those attributed to individuals
- Include mathematical and scientific practices that were passed down through oral tradition
- Refer to examples of mathematical and scientific principles that relate to the everyday experiences of students in the context of their various cultures and gender

Confronting stereotypes. Children receive messages about gender and ethnic stereotypes every day, from television programs and commercials, from books, from the adults around them. They also pick up stereotypes about scientists: that they are all men, that they are all White, that they are crazy or

All children can achieve

"Latàsha, what's another way of saying 20 one-hundredths?"

"Two-tenths!"

"Right."

"Matthew, is 15 composite or prime? How do you know?"

"Composite, because 15 breaks up into threes and fives, not just ones."

"Good."

"Melody, what's a rhombus?"

"It's a parallelogram, with equal sides."

On their way to the lunch line, students in the cafeteria at Woodlawn Early Childhood Education Center in Portland, Oregon, barely break stride as they answer Jan Gillespie's gentle quizzing. Touching a shoulder here and there, Gillespie moves through the young crowd, posing her mathematical questions while dishing out healthy servings of personalized attention.

For the past 11 years, Gillespie has been the mathematics specialist at Woodlawn, nine years of that time under the leadership of Principal Linda Harris. Both women are leaders in Oregon's education circles.

Their professional achievements are the fruits of a shared philosophy that all children can achieve higher standards. Woodlawn's students have proved this point. Most of the school's 525 students are from working-class African American families and are receiving school lunch assistance. Contrary to the perceived link between poverty and low achievement, Woodlawn's students have scored high in state and district mathematics tests in recent years.

Harris gives much of the credit to Gillespie, who co-authored a hands-on/"minds-on" mathematics program that has been adopted schoolwide. Gillespie's programs, *Every Day Counts*™ and *Math Every Day*, is now used in schools and districts throughout the country, including Oregon and Washington.

In 1996, Woodlawn's fifth-grade students outperformed students in schools throughout the state in mathematics, scoring 12 points higher than the state average. A dozen schools equaled or surpassed Woodlawn's score, but all had significantly higher socioeconomic status (SES) rankings: Woodlawn's SES ranking was 14, while the other schools had SES rankings ranging from 189-709 (Oregon Department of Education, 1996).

"Disadvantaged kids can do well if given appropriate instruction," Harris says, "and if you believe they can do it."

Harris also has high expectations for her teachers. Each spring, they work together to identify goals for the coming year and to schedule teacher training to help teachers achieve those goals.

"Here at Woodlawn, teachers take a lot of initiative with their own learning," says Harris.

When she and her staff decided to adopt Gillespie's mathematics program, Harris knew that she was asking a lot from her teachers. They would need to learn how to use the new mate-

rials and how to adapt their teaching style to the program's emphasis on language, cooperative learning, and hands-on activities. Trusting Harris' leadership and Gillespie's expertise, the staff met during time normally set aside for faculty meetings to learn the new program.

Gillespie's approach to mathematics includes an emphasis on problem-solving, reasoning, collaboration, visual, mental, and hands-on experiences. Daily bulletin board math discussions, which teach basic computation skills

through record keeping, are combined with activities and partner games. Each day, students and teachers update data on the board and discuss the new mathematical relationships which appear. Thus, students at every grade level analyze data, perceive patterns, explore mathematical relationships, and communicate their thinking.

Twice a week, Gillespie visits each math class and, using manipulatives and arrays to provide concrete examples, leads the students in mathematical explorations of grouping and counting, mental math, and partner games.

Gillespie and the other teachers are careful to use full and accurate sentences when explaining an algorithm or a grouping concept, teaching students to use language as a bridge from concrete examples to abstract ideas. For example, 12 divided by five might be acted out or read back as "twelve shared with five people gives each person two, with two leftover." (For more information about Gillespie's programs *Every Day Counts*™ and *Math Every Day*, see Curricula listing under "Resources".)

Harris has instituted a variety of programs and activities, all meant to further the school's mission to "develop the minds and characters" of its young charges. There are after-school activities that reinforce the curriculum, such as Math Club and Hands-On Science night. Parents can check out math videos from the library and are invited to attend family mathematics and science nights throughout the year, as well as a monthly Family Fun Night.

The power of these strategies, combined with good teaching, can spell the difference between lifting struggling students up—so that they can reach their higher potential—and leaving them to muddle through, or drop out, on their own.

"All children can achieve if you provide them with a safe and nurturing environment that includes a high level of expertise among your teachers," says Harris.

obsessed, that they are nerds. Because of this mad scientist image, many students cannot or do not wish to envision themselves as mathematicians or scientists (Hyde et al., 1990). To accept mathematics and science as attractive career options, females and students of color need to know how to recognize and overcome stereotypes. Teachers cannot control all the messages students receive, but they can confront sex and culture bias by discussing it in class. Students also learn how to overcome stereotypes when they learn about and meet female scientists and scientists of color.

Mathematics and science are for everyone. Girls and students of color often get the message that they are outsiders in mathematics and science classrooms. Because they tend to have fewer scientific experiences out of school, they are not as familiar with the concepts, materials, and tools (Kahle, 1990).

Problems and activities in mathematics and science are more likely to be tailored to boys' interests, rather than girls' (Fennema & Peterson, 1987; Stallings, 1985). As a result, girls are often taught, subtly, that they must learn to think like boys or be more like boys if they want to succeed in these subjects.

Girls often find encouragement in after-school mathematics and science clubs. By joining these clubs, girls are exposed to a variety of activities. Girls who enjoy mathematics and science often feel isolated. They enjoy the social aspect of the clubs because they meet other girls who share their interests. The clubs help link mathematics and science to the world outside the classroom: They become meaningful activities, not just school subjects. Because the activities take place in an informal setting, girls are free to experiment and make mistakes without the pressure of getting the right answers.

Students of color often lack prior exposure to mathematical and scientific concepts and have had few role models in those fields. Because inequity in education has been long-standing, the parents of students of color often have had little opportunity to obtain a strong education in mathematics and science. Therefore, they are often less able to serve as role models in the study of mathematics and science to encourage their children to pursue these subjects.

To put all students on common ground, teachers must make sure that mathematics and science are inviting to all students. The following are a few ways to make students more comfortable in mathematics and science (Campbell, 1995; Clewell et al., 1992):

- Allow students to read and work problems before lectures, class discussions, and lab work. If students have a chance to familiarize themselves with the material, they will be able to ask better questions and construct their own understanding.

■ Provide unstructured time for students to "mess around" with equipment and tools.

■ Make sure that all students are active participants in hands-on activities; have students rotate tasks so that everyone has a chance take an active role.

■ Monitor the context of problems and activities to be sure that they are meaningful and relevant to the lives of all students.

Classroom interactions. The teacher's attention is the most valuable resource available to students. Teachers must ensure that all students participate equally in class, and there are many ways to make classroom interactions more equitable:

■ When asking for a show of hands, do not call on the first students who respond but wait a few moments. Girls often take longer to raise their hands because they do not want to risk being wrong (Kaplan & Aronsen, 1994; Sandler, 1992).

■ Develop a routine for class discussions so that everyone participates on a rotating basis. All students will be able to participate more and will get more attention. It also sends the message that all students are expected to know the answers and to do well.

■ Give students more time to produce an answer. When teachers increase wait time all students will have the chance to raise the level of their answers.

■ Encourage guessing and thinking out loud as ways of learning mathematics and science. This takes the emphasis off competition and speed, creating an atmosphere that is more comfortable for girls (Corey et al., 1993).

■ Provide meaningful and fair comments when interacting verbally with students. Teachers tend to praise a girl's work for neatness—while remarking on the content of a boy's work—and they often comment on the behavior of students of color, rather than on their schoolwork (Atwater, 1993; National Center for Educational Statistics, 1995).

She likes math!

AWSEM (Advocates for Women in Science, Engineering, and Mathematics) is a project of Saturday Academy at Oregon Graduate Institute of Science and Technology. Through the AWSEM program, girls participate in after-school science and mathematics clubs. The girls meet every week from October through May. The AWSEM clubs are led by female college students majoring in mathematics and science related fields. The leaders are role models for the participants because they are close to the girls in age and the girls can identify with them. The clubs are also monitored by teachers from the girls' schools.

Three AWSEM meetings of every month are spent on mathematics and science activities. The students participate in hands-on projects, work with computers and other equipment, conduct experiments, and engage in debates. They gain confidence in their mathematics and science abilities and begin to see themselves as experts. Girls experience learning mathematics and science as a social activity.

One meeting of every month is devoted to a site visit. Students meet women working in scientific and technological fields. They learn about jobs in such fields as land use, software product development, and medical research. In addition to explaining their work, the practitioners lead the students in an activity that helps the girls better understand aspects of the job.

Students enjoy the AWSEM program because "it's a fun, interactive science club for your friends," and because they learn "how women can change the world." The clubs also impact the students' experiences in school. As one parent affirms, "[AWSEM] has turned my daughter's direction around. I was concerned she was losing interest in school.... Her grades started dropping. Since being honored by being chosen by AWSEM...her self esteem has skyrocketed and her grades are great. She now says she likes math!"

This is the third year of the AWSEM program, which began in the Portland area, but now includes four regional sites in Oregon and one in southern Washington. AWSEM has recently been adopted by Women in Technology International (WITI) as its model program for young women and will become a national resource.

All teachers need to continuously evaluate their interactions with students for equity. There are several ways to do this: A teacher might videotape her classes and do a self-evaluation. Two or more teachers could observe each other and suggest areas for improvement. A teacher might also ask students to act as observers and data collectors to gather information about classroom interactions. Empower students to speak up when they feel excluded. These strategies will give students essential tools to use throughout their schooling—indeed, throughout their lives. Students will gain the confidence to address bias in other classrooms and in the workplace.

Learning styles. Although culture can influence learning styles, students who share a cultural background don't always share the same learning preferences. A teacher's overarching goal should be to discover the specific learning needs of his or her individual students. Nevertheless, understanding the link between culture and learning can be helpful when choosing instructional techniques and curricula to meet the needs of all students.

Barba (1995) lists several key factors influencing the degree to which students are socialized to school culture: the level of assimilation with the dominant culture; country of origin; and family beliefs, values, and attitudes. "While some children have been taught by their parents and community to value reading books, other children have been taught to value listening to elders," she points out.

Many African American, Hispanic (Barba, 1995), American Indian, and Alaska Native students (Reyhner & Davison, 1992) find the expository model of teaching—lecturing at length from the front of the classroom—culturally

unfamiliar and prefer visual and tactile modes of instruction. Many students respond more readily to personal interaction, hands-on activities, small-group discussions, and culturally relevant analogies and curricula.

Using a variety of teaching strategies provides students with multiple ways of connecting with the material. Especially for students with diverse language skills, using icons, real-world objects, and pictures serves to stimulate a student's prior knowledge—knowledge that often was constructed in their home language. Slides, transparencies, photographs, drawings, and diagrams can help address the language needs of many students (Barba, 1995).

Ability grouping/tracking. Though the benefits of ability grouping and tracking have been challenged for over a decade (Oakes, 1985, 1990), the practices persist, especially for African American, Hispanic, and Native American students (NCES, 1995). Research indicates that tracking is not effective in raising the academic achievement of low-tracked students (Barquet, 1992; Gamoran, 1992). In fact, it undermines their academic achievement, is destructive to their self-esteem, and often consigns them to a lifetime of limited options (Oakes, 1985). Students often lose confidence in their abilities, grow bored by less demanding curricula, and lose interest in mathematics and science. Students who have been tracked are frequently steered away from taking advanced classes—severely limiting their college and employment opportunities. Though the research is not conclusive on this point, there are indications that high-achieving students can also benefit academically from learning in mixed-ability classes, especially when tutoring their classmates in small-group situations (Oakes, 1985; Barba, 1995).

Low-track mathematics classes usually emphasize basic computational skills and arithmetic facts (such as multiplication tables) and "good" behavior (Oakes, 1985), rather than reasoning and inquiry. Students are more likely to read from a textbook and complete worksheet problems. They are less likely to participate in hands-on activities and be asked to explain, in writing and verbally, their reasoning behind their solution to a problem (NSF, 1996).

All students need mathematics instruction in content areas that have been traditionally divided between high- and low-ability classes. All students need to learn about "mathematical ideas, concepts about numeration systems, mathematical models, probability, and statistics" in addition to computational procedures and algorithms (Oakes, 1985; NCTM, 1989).

Cooperative learning. In her landmark book, *Keeping Track* (1985), Jeannie Oakes promotes cooperative learning as an effective alternative to ability grouping. The effectiveness of cooperative learning in mathematics and science seems well established in the research (Secada, 1992; Atwater, 1994). When coupled with high expectations, cooperative learning can improve students' academic achievement and help them to develop greater self-confidence, more cross-cultural understanding, and enhanced social skills (Kober, 1991).

Cooperative learning affords students opportunities to use higher-order thinking skills—posing their own questions, planning investigations, and communicating their findings—and to learn valuable social skills, such as peer tutoring, and respecting cultural and learning differences.

While any student who feels anxious about mathematics or science is likely to feel safer in small groups, some students seem to respond particularly well. African American and Hispanic children benefit from small, cooperative learning groups, especially in environments that involve learning tasks that focus on whole concepts or real situations rather than fragmented skills or abstractions. (Oakes, 1990) For many culturally diverse children, working in a group in the classroom closely resembles their home environment where working with family members is a common occurrence.

Students whose primary language is not English also respond well to small-group learning. While engaged in peer tutoring, students who share a language can talk to one another in their home language to explain and to clarify. This allows them to construct new knowledge in their home language, and then discuss it again in English with their group and with the classroom as a whole. In addition to facilitating the acquisition of content, the social interaction involved in this process improves students' understanding of the English language and its usage.

In cooperative learning, the role of the teacher changes from that of dispenser of knowledge to a facilitator of learning. Far from relinquishing control of the classroom, teachers function as "expediters, evaluators, coaches, mentors, navigators, managers, mediators, and lecturers" (Barba, 1995). Cooperative learning is most effective when teachers interact frequently with groups, have short-term goals for each group, and transition smoothly from small-group to whole-class discussion. It is also best when students regroup frequently; subtle hierarchies often emerge when students stay in one group for too long.

Hands-on activities. Most educators agree that the best way to learn science is to do science—from kindergarten through graduate school (Gibbons, 1992). Young students' learning of mathematics and

science is strongly linked to their concrete experiences and sense perceptions.

"Only after they have experienced ideas on a concrete level do children progress toward an understanding of symbols and abstract concepts," says Nancy Kober in *EdTalk: What We Know About Mathematics Teaching Learning* (1991). With their visual, auditory, and tactile qualities, manipulatives promote active learning, build motivation and, often, allow students to experience the thrill of discovery (Oakes, 1985).

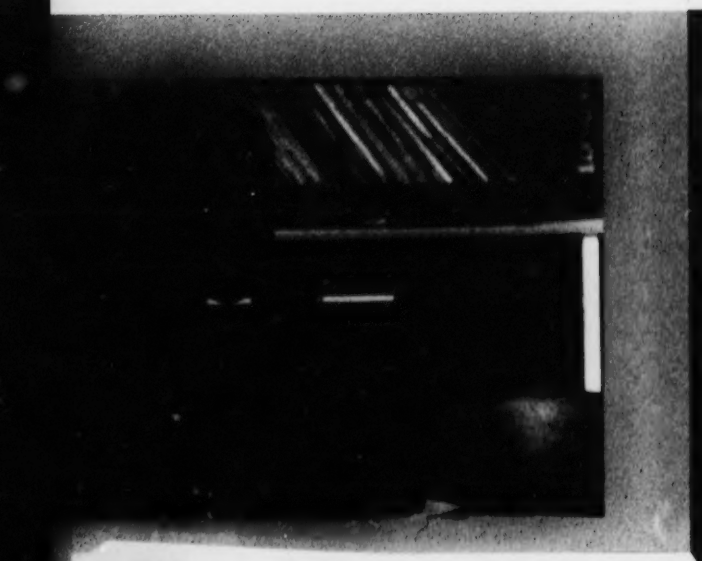
Hands-on activities can be especially helpful to students with language barriers (Mason & Barba, 1993). Hands-on learning presents diverse language learners with a wider window to mathematics and science understanding. Visual aids, such as pictures, models, drawings, and objects, enhance verbal instruction. Props, cues, body language, and demonstrations also help circumvent perceived language barriers and turn the learning of science into an engaging and meaningful process (Barba, Pang & Tran, 1993).

Single-sex grouping. For some time now, single-sex schools have been getting a lot of attention from people interested in gender equity. Girls who attend these schools have higher achievement in mathematics and science and are more likely to choose mathematics and science-related majors and careers (Jiminez & Lockheed, 1989; Lee & Bryk, 1986; Tidball, 1986).

Some schools have experimented with all-girl classes as a way to address many of the factors that exclude girls from mathematics and science. The classes are usually less competitive and therefore more comfortable for girls. Because of the supportive atmosphere, girls feel more at ease to ask questions, make mistakes, and take risks (Dagenais et al., 1994).

One problem that single-sex classes have attempted to address is the fact that many girls are intimidated and inhibited by boys, especially during the middle-school years. Girls often feel pressure to hide their intelligence and abilities (Kramer, 1985). Placing girls in single-sex environments, even briefly, gives them a chance to overcome their inhibitions. Extracurricular activities such as mathematics and science clubs are another idea some schools have used to provide a supportive environment that can increase girls' confidence in class as well.

Another approach has been to design "girl-friendly" mathematics and science classes, for example, highlighting the work of female scientists. The focus is on girls, but the classes do not exclude boys. Occasionally, teachers may have students work in same-sex pairs or groups within coed classes. This ensures that girls have a chance to participate and lead activities.



As caribou trek across the still-frozen tundra near Alaska's Koyukuk River, students from Huslia watch while adults from the village begin the spring hunt. The students are observing and collecting data in order to answer such questions as, What size are caribou hooves? How does a herd choose a leader? Do Eskimos use caribou differently than Indians?

The entire student body from Jimmy Huntington School, grades K-12, takes part each year in an integrated science project. The caribou project, developed by teacher Michele Bifelt, is one of several inquiry-based curricula that link multiple disciplines and help students make connections between their formal learning and their cultural experiences.

After students brainstorm questions for their caribou research, they write letters to wildlife agencies and universities; they interview village elders and hunters; and they record data from their observations at the caribou migration and hunt. Back in the classroom, they write a summary of their research and make maps and graphs of herd sizes and migratory ranges.

The project has helped Huslia's students to improve their basic science skills and has inspired more parents to participate in students' science projects and lessons (Braunger & Hart-Landsberg, 1994). (See listing in "Resources.")

However, single-sex mathematics and science groupings are very controversial, and more research is needed. Although they may address inequities that occur in coeducational schools and classrooms, some experts note that these groupings are a violation of Title IX, the federal law prohibiting sex discrimination in schools receiving federal financial assistance, and they question the soundness of this remedy (General Accounting Office, 1996). Some argue that separating girls from boys may give students the message that girls are lacking and can't learn mathematics and science the "right" way (Pollina, 1995). Single-sex classes do not necessarily change the way teachers conduct their classes and interact with students. Even in all-girl classes, some teachers will continue to teach mainly to the most vocal students.

The importance of connection.

For many students, mathematics and science seem less accessible than other subjects. Research shows that female students are less familiar with the uses of mathematics and science in everyday life (Armstrong, 1985; Fennema & Sherman, 1978). Some students of color find these subjects irrelevant to their lives and unconnected to their life goals (Reyhner & Davison, 1992).

Mathematics and science are more relevant and accessible when they connect to students' personal experiences. Teachers can establish these connections, and they can encourage students to make their own connections. It isn't necessary or practical to always make instruction culturally relevant. But whenever possible, providing culturally meaningful examples, analogies, and materials can help students make that vital link from their real-world experiences to new knowledge (Mason & Barba, 1993) (Reyhner & Davison, 1992).

No matter what their learning styles, students are more engaged when activities and curricula are authentic and reflect subjects that interest them (Martinez, 1992). Mathematics and science come alive when students learn about how they are applied to social problems and how they are used to improve peoples' lives. For example, students may explore issues such as the role of recycling in environmental management or the ways science and technology can be used to help people with disabilities. Students will also be engaged by discussions about ethics and controversial issues such as nuclear power.

Writing. Informal writing activities are a way for students to connect science and mathematics to their own experiences. Teachers can make journals or reflection papers a regular part of classroom activities. In their journals, students can reflect on what they are learning and create meaning for themselves (Countryman, 1992).

The national standards emphasize the importance of language and communication in learning mathematics and science. When students write about mathematics and science, they deepen their understanding. Getting the right answers is not always the most appropriate learning goal. Students must also know why their answers are right and be able to identify multiple solutions. Encouraging students to write down lingering questions takes the emphasis off always having the right answer.

Mathematics and science require students to learn new terms and to decode technical language. Students increase their understanding when they put the concepts they have learned into their own words (Rivard, 1994; Zinsser, 1988).

Teachers can also use journals to identify topics that students have misunderstood. In their writing, students can be asked to explain areas in which they are struggling. Students must then examine their difficulties, a process that moves them past the dismissive, "I don't get it." Teachers can use this information to pace instruction; to decide when a topic has been covered thoroughly or when more clarification is needed; and to focus review sessions before tests (Santiago & Spanos, 1993).

Journal writing is also a useful tool for improving students' attitudes toward mathematics and science. Students can express their anxiety or frustration, which they may not be comfortable speaking about in class. Teachers can also ask students to reflect on their own progress, which they may otherwise overlook (Countryman, 1992).

The informal nature of the exercises ensures that they are accessible to all students, regardless of their writing proficiencies. Journal writing may offer students who are not yet proficient in

English a personal process for connecting what they are learning with their own experiences, while putting less emphasis on grammar, punctuation, lexicon, and style of dialect. Instead, the focus is on articulating and then reflecting on their own learning and progress (Tippins and Dana, 1993).

Career awareness and role models. Career awareness is an important tool in promoting the participation of females and students of color in mathematics and science. Students are more motivated when they see these subjects as useful and relevant to their future education and career plans.

Traditionally, teachers have not encouraged students to think about their career plans until high school, but research indicates that this is too late. Experts recommend that students begin learning about careers and exploring their interests in elementary and middle school (Clewell et al., 1992). Students need exposure to female and culturally diverse scientists at an early age to counteract stereotypes and send the message that mathematics and science are things done by people like themselves. All students need to see science-related careers as open to them (Smith & Erb, 1986).

One way of exposing students to women and people of color in scientific and technological careers is to bring in professionals for classroom visits. The speakers can describe their jobs and career fields, explain their academic backgrounds, and relate their experiences to what students are learning in school. Field trips or industry tours are another way for students to get information about work environments and to see firsthand how learning relates to real-life workplace situations. Visiting worksites can also dispel such widely held beliefs as the notion that scientists only work in laboratories and in isolation. Students gain more indepth knowledge from activities such as job shadows, internships, and service learning.

Career awareness should also focus on how mathematics and science are used in all careers, not just scientific and technological fields. For example, mathematical skills are important for business careers, including marketing, banking, and retail. Students can learn about the relevance of mathematics and science by interviewing adults about how they use mathematics and science in their work.

Mentors. Adult mentors are another way to encourage students' self-confidence and promote perseverance in mathematics and science (Clark, 1993). They develop sustained personal relationships with a student and in addition to being role models, can provide personal guidance and support.

Mentors also encourage students to learn about, and possibly pursue, careers that they might not otherwise have consid-

ered. Students may also talk to their mentors about their fears and the pressures they may be feeling, particularly as females and minorities. Mentors can confirm that these pressures are real, that all women and people of color experience them, and, more importantly, that they can be overcome.

Finding mentors for students in rural communities can be especially challenging. One option is to establish an online mentorship through e-mail or through the postal mail. For example, the Rural Girls in Science Program, a summer science camp at the University of Washington, pairs each student with a female scientist. The students work on a year-long research project and keep in touch with their mentors via e-mail.

Peer mentoring. Although not as directly tied to careers, peer mentoring is another way to encourage females and minorities in mathematics and science. In these programs, high school or college students are paired with younger students to help them with their school work. Peer mentors are also powerful role models. They are close to the students in age and circumstance, which gives them extra influence and credibility (Clewell, et al., 1992). The younger students can easily identify with them as successful students in mathematics and science.

Assessment. While holding high expectations for all students is an important tool for achieving equity, these expectations bring up another equity consideration. Students must have equal opportunities to demonstrate what they have learned. Making assessment more equitable means rethinking its purpose. Instead of using tests to define students as lacking, equitable assessments are used to *improve learning* and to assess how well instruction and curricula are meeting the learning needs of all students.

Fair, unbiased assessment takes into account prior knowledge, cultural experience, language proficiency, cognitive style, and interests. Good assessment must also accommodate differences in the way students display their mathematical and scientific learning. To ensure that all students have an equal opportunity to demonstrate their abilities, teachers can use a variety of assessment methods. Alternatives to multiple choice tests include such performance evaluations as short-answer questions, essays, portfolios, oral presentations, and demonstrations (NCTM, 1995).

"This is what real scientists do!" "This is a lot better than reading science out of a book." This is how fifth-grade students at Seattle's Dearborn Park Elementary School responded after they and their teacher, Jan Hunt, began participating in a hands-on, inquiry-based science program.

The Seattle Partnership for Inquiry-Based Science provides Seattle School District K-5 teachers with 100 hours of science training, including mentoring and training with volunteer scientists from the University of Washington, Fred Hutchinson Cancer Research Center, and The Boeing Company.

The scientists also participate in Family Science programs, such as an event in which students and scientists team up at stations to guide family members through science activities. Family members are also invited to take part in Science Awareness Workshops for Parents, undertaking some of the same science investigations their children are doing in the classroom.

Equitable assessment may be one of the most challenging aspects of mathematics and science reform. Much more research is needed to identify how to make the new standards and assessment work for all students. "We have much to learn about how to maintain uniformly high performance standards while allowing for assessment approaches that are tailored to diverse backgrounds. Uniform application of standards to a diverse set of tasks and responses poses an enormous challenge that we do not yet know how to do fairly and effectively." (National Research Council, 1993).

Family involvement

One of the influential factors in a student's educational success is the level to which that student's parents participate in his or her education. According to the National Science Foundation publication, *Women, Minorities, and Persons With Disabilities in Science and Engineering 1996*, "Parental education is the single most important predictor of participation in mathematics and science. Parents serve as role models and mentors in encouraging their children to have high educational aspirations."

Some parents need extra support and encouragement to get involved in their children's education. Parents are more likely to get involved when they know their child's classroom welcomes them in meaningful and sustained ways; when parents and guardians are invited to special activities, family mathematics and science nights, and Saturday seminars; and when schools can direct them to social services that offer assistance in English as a second language, parenting, and adult education.

When parents or guardians become involved in their child's education, the positive effects are numerous: Children's academic achievement improves, their interest in science and mathematics improves, their awareness of career options increases (Barba, 1995) and they are more likely to choose mathematics and science majors in college (Oakes, 1990).

Professional development

Much has been written about the need to provide teachers with professional development opportunities so that they can effectively carry out the goals of education reform (American Association for the Advancement of Science, 1990; National Council

for Teachers of Mathematics, 1991; Quality Education for Minorities Project, 1990). It is teachers who are implementing new standards, using multiple teaching styles and assessment practices, transforming curricula to be more equitable, bringing families into the school—in short, making reform a reality. To provide quality education for all students, teachers themselves need quality, ongoing professional development.

The Eisenhower Professional Development Program, one of the largest sources of funding for teacher training in science and mathematics education, places a high priority on equity. It requires activities supported by Eisenhower funds to "incorporate effective strategies, techniques, methods, and practices for meeting the educational needs of diverse groups of students, including girls and women, minorities, individuals with disabilities, limited English proficient individuals and economically disadvantaged individuals."

Teachers need opportunities to further their knowledge about current practices and research in their fields of expertise; to study child development and research about learning; to communicate and collaborate with colleagues; to learn additional languages; and to learn about equitable teaching strategies, curricula, and assessment practices.

When teachers take the initiative in their own diversity training, the investment can pay many, and lasting, dividends—for teachers and their students. Below are a few ways teachers can deepen their understanding of differences and cultivate a classroom climate that values diversity (NCTM, 1991; National Coalition of Educational Equity Advocates, 1994; Center for National Origin, Race and Sex

Equity, 1996; Derman-Sparks & the A.B.C. Task Force, 1989).

(See "Resources" section for more information on the organizations and online resources mentioned below.)

Teachers can:

- Request training in teaching heterogeneous classes, using cooperative learning, and using other strategies that meet the diverse needs of all students

- Seek opportunities for further study in their field (for example, the Teacher Research Associates Program at the Pacific Northwest National Laboratory in Richland, Washington)

- Do further reading in child development, learning styles, and how children learn

- Explore online multicultural and gender resources for teaching strategies, curriculum modules and materials, and assessment devices

- Participate in staff development training to learn how to recognize and manage bias

- Evaluate their own opinions and behavior from the students' perspective; ask themselves, "What is the effect of my actions and words?"

- Organize a support group of administrators and teachers; offer feedback on classroom effectiveness; and explore opportunities for integrating subjects

- Request training and support from such organizations as the Center for National Origin, Race, and Sex Equity at the Northwest Regional Education Laboratory, and Northwest EQUALS at Portland State University, in Portland, Oregon

- Participate in multicultural activities in their own community and spend time in culturally diverse neighborhoods

- Learn an additional language

- Read current literature and professional journals that provide thoughtful commentary on equity and useful activities for the classroom (for example, *Teaching Tolerance* magazine, and NSTA and NCTM journals)

Conclusion

Making mathematics and science accessible and inviting for all students requires commitment, flexibility, and perseverance. The strategies presented in this publication are important tools, but they will not work for everyone. Each teacher must reflect upon and choose what works in his or her classroom. The following pages provide a list of resources that teachers may find helpful as they strive to implement equitable teaching strategies.

Resources & Bibliography

Publications

Apelman, M., & King, J. (1993). *Exploring everyday math.* Portsmouth, NH: Heineman.
Ideas for teachers and parents on making connections between mathematics and the daily lives of elementary school students.

AWSEM (1997). *Directory of practitioners: Role models for young women.* Portland, OR: Saturday Academy.
A list of Oregon women in science and technology fields who are willing to visit schools and work with students.

Gross, F., et al. (1993). *The power of numbers, a teacher's guide to mathematics in a social studies context.* Cambridge, MA: Educators for Social Responsibility.

Nelson, D., Gheverghese, J., & Williams, J. (1993). *Multicultural mathematics, teaching mathematics from a global perspective.* New York, NY: Oxford University Press.

Parker, M. (Ed.). (1995). *She does math! Real life problems from women on the job.* Washington, DC: Mathematical Association of America.
Career histories of professional women with math problems they have written based on their jobs. Grades 9-12.

Sanders, J., & Rocco, S. (1994). *Bibliography on gender equity in mathematics, science and technology: Resources for classroom teachers.* New York, NY: Gender Equity Program, Center for Advanced Studies in Education.

Skolick, J., Lanbort, C., & Day, L. (1992). *How to encourage girls in math & science.* Englewood Cliffs, NJ: Prentice Hall.
Activities and strategies to help girls develop math and science confidence and skills.

Tobias, R. (1992). *Nurturing at-risk youth in math & science. Curriculum and teaching considerations.* Bloomington, IN: National Educational Service.

Warren, R.L., &. Thompson, M.H. (1994). *The scientist within you: Experiments and biographies of distinguished women in science.* Eugene, OR: ACI Publishing.
Hands-on experiments and activities inspired by the work of women scientists. Grades 3-8.

Zaslavsky, J. (1993). *Multicultural mathematics.* Portland, ME: Weston Walch.

Publications center

Womens Educational Equity Act Publications Center. Resources for teaching strategies and activities to encourage female students, such as *Gender-Fair Math, A Mindset for Math: Techniques for Identifying and Working with Math-Anxious Girls,* and *Science EQUALS Success.* Publications list available online at http://www.edc.org/CEEC/WEEA/pubs/publist/mst.html. For more information, contact:
WEEA Equity Resource Center
55 Chapel Street, Suite 200
Newton, MA 02158-1060
(800) 225-3088

Curricula

Caribou/Fisheries Project–
A culturally relevant K-12 integrated science project, created by teacher Michele Bifelt at Jimmy Huntington School in Huslia, Alaska. Curricula guidelines available from the Northwest Regional Educational Laboratory, Science and Mathematics Education, 101 SW Main Street, Suite 500, Portland, OR 97204. For more information about the project, contact Michele Bifelt, P.O. Box 69, Huslia, AK 99746 (mail inquiries only).

***Every Day Counts*™ calendar math and *Math Every Day* primary mathematics program–**Co-authored by Portland teacher Jan Gillespie and published by D.C. Heath, *Every Day Counts*™ is a K-6 supplementary bulletin board mathematics program revolving around a calendar and other visual elements, i.e., clock, coin counter, daily measurement, depositors, fraction-a-day, daily decimal, and graphs. *Math Every Day* is a complete K-2 primary math program which includes *Every Day Counts*™ and investigations, projects, and partner games. For more information, contact Jan Gillespie, Woodlawn Early Childhood Education Center, 7200 NE 11th, Portland, OR 97211, (503) 287-6272.

Organizations

Alaska Department of Education
801 W. 10th Street, Suite 200
Juneau, AK 99801-1894
http://www.educ.state.ak.us/
Nanci Spear, Math & Computer Specialist, (907) 465-8718
Peggy Cowan, Goals 2000/Frameworks Coordinator, (907) 465-2826
Anne Kessler, Native and Indian Education, (907) 465-8716

Alaska EQUALS
Gretchen Murphy, Stephanie Rudig
3504 Kreb Drive
Fairbanks, AK 99709
(907) 479-8224 or (907) 457-2124

Professional development, workshops, and curriculum materials in mathematics and science, including equity, for teachers and parents.

The Annenberg/CPB Math and Science Project–Improving Math and Science Education
PO Box 2345
S. Burlington, VT 05407-2345
(800) 965-7373
http://www.learner.org/content/k12/

Mathematics and Science for All–
A video/book series highlighting successful mathematics and science education reform projects in Montana. *Native American Students* features the Systemic Teacher Excellence Preparation (STEP) project which provides teachers with training and early career support. The series also includes *Students with Special Needs* and *Support for Rural Education*. Online resources include: *Journey North*, a global study of wildlife migration and seasonal change; a resource catalogue of videos, software and print guides; and a guide to mathematics and science reform, an interactive database.

AWSEM–Advocates for Women in Science, Engineering & Mathematics
Saturday Academy
Oregon Graduate Institute of Science and Technology
PO Box 19000
Portland, OR 97291-1000
(503) 690-1261
Fax (503) 690-1470
E-mail: awsem@admin.ogi.edu
http://wwide.com/awsem.html
Hollis MacLean, Project Director

Center for National Origin, Race, and Sex Equity
Northwest Regional Educational Laboratory
101 SW Main Street, Suite 500
Portland, OR 97204
(503) 275-9603
E-mail: harrisj@nwrel.org
http://www.nwrel.org/cnorse/
Joyce Harris, Director

CNORSE provides training and technical assistance free of charge to public school personnel in all equity-related areas, including racial and sexual harassment; access to equity resources; and offers referral services. Online resources include upcoming events and publications, *Equity Infoline* newsletter, and links to other equity Web sites.

The College Board's Equity 2000
45 Columbus Avenue
New York, NY 10023-6992
(212) 713-8268
Vinetta Jones, National Director
http://www.collegeboard.org/equity/html/info001.html

A national education reform project focusing on increasing the participation and achievement of minorities in mathematics and science. It offers summer institutes for mathematics teachers. In addition to strengthening their content knowledge, teachers learn to use cooperative learning and a variety of experiential learning activities to meet the needs all students.

Idaho State Education
PO Box 83720
Boise, ID 83720-0027
(208) 332-6800
http://www.sde.state.id.us/
LaRon Smith, Coordinator, Math and Science
Barbara Eisenbarth, Equity Specialist

GESA: Gender/Ethnic Expectations, Student Achievement
22821 Cove View
Canyon Lake, CA 92587
(909) 244-51655

Provides training to help teachers identify and eliminate gender and ethnic bias in classroom interactions.

Montana Office of Public Instruction
1300 11th Avenue
Helena, MT 59620-2501
(406) 444-3693
http://161.7.114.15/opi.html
Division of Educational Opportunity & Equity
(406) 444-4420
BJ Granbery, Administrator

Northwest Center for Research on Women
University of Washington, AJ-50
Seattle, WA 98195
(206) 543-9531
Fax (206) 685-4490
E-mail: nwcros@u.washington.edu
Jane Bierman, Project Director
Katie Frevert, Project Director

Northwest EQUALS
Portland State University
PO Box 751
Portland, OR 97207
(503) 725-3045

Professional development, workshops, and curriculum materials in mathematics and science, including equity, for teachers, parents, and community members.

Northwest Regional Educational Laboratory
Science and Mathematics Education
101 SW Main Street, Suite 500
Portland, OR 97204-3297
(503) 275-9500

Kit Peixotto, (503) 275-9594
E-mail: peixottk@nwrel.org
http://www.nwrel.org

NWREL provides leadership, expertise, and services to the region based on research and development. The Science and Mathematics Education (SAME) unit provides services in support of effective curriculum, instruction, and assessment, and maintains a lending library of books, videos, and other materials on gender and culture equity, technology in the classroom, education reform, standards and assessment, and curriculum.

Oregon Department of Education
255 Capitol Street NE
Salem, OR 97310-0203
http://www.ode.state.or.us//
John Bridges, Mathematics Specialist,
(503) 378-8004 x225
Marilyn Husser, Specialist,
(503) 378-5585 x250

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy
PO Box 999
Richland, WA 99352
(509) 375-2121
Teacher Research Associates Program—Eight-week program for secondary teachers of science, mathematics, and technology. Teachers work with scientists and engineers in current areas of research, using state-of-the-art technology. **Science Alive: Building a Community of Elementary Science Teacher-Leaders**—Summer workshop in which teachers work with scientists and engineers in solving simulated research questions, with an emphasis on inquiry-based teaching/learning.

Science and Mathematics Consortium for Northwest Schools (SMCNWS)
Ralph Nelsen, Director, SMCNWS
Columbia Education Center
171 NE 102nd
Portland, OR 97220-4169
(503) 760-2346
E-mail: ralph@col-ed.org
Equity Specialists:
Barbara Eisenbath, (208) 332-6953
Joy Wallace, (503) 252-4999
http://www.col-ed.org/smcnws

Disseminates promising educational programs, practices, and materials; provides technical assistance and training in support of state and local initiatives for quality science and mathematics content, curriculum improvement, and teacher enhancement.

Washington MESA (Mathematics, Engineering, Science Achievement)
MESA State Office
University of Washington
353 Loew Hall, Box 352181
Seattle, WA 98195
(206) 543-0562
http://wa-mesa.engr.washington.edu/

Assists middle and high schools increase the participation and achievement of underrepresented students in mathematics, engineering, and science. Assists teachers in implementing instruction and assessment practices that align with state and national standards, and creating curricula that integrate mathematics, science, and technology. MESA's *Real World Mathematics Through Science for Teachers* is an online professional development program providing ongoing instruction and support for teachers implementing MESA curriculum modules.

Washington Office of the Superintendent of Public Instruction
Old Capitol Bldg.
PO Box 47200
Olympia, WA 98504
(360) 753-6738
http://www.ospi.wednet.edu/
Mitzi Beach, Director,
Equity Education, (360) 753-3220
Peggy G. Vatter, Supervisor,
Science/Mathematics Technical Assistance, (360) 753-6757
Washington Commission on Student Learning: http://csl.wednet.edu/

Online resources

Alaska Web Servers
http://www.arsc.edu/misc/alaskawebservers.html

The Arctic Region Supercomputing Center maintains a listing of 180 Web servers for academic, commercial, government, and nonprofit organizations.

Campbell-Kibler Associates, Inc.
http://www.tiac.net/users/ckassoc/

Free pamphlets on gender equity in mathematics and science available for downloading (Adobe Acrobat format).

Equity Education Online
http://www.etdc.wednet.edu/equity

Includes organizations, research, information on tools and materials, and student success stories.

Equity Regional Network (part of the Regional Alliance for Mathematics and Science Education Reform)
http://ra.terc.edu/regional_networks/equity/equity.html

Links to other equity Web sites; listserv on current issues and strategies.

Exploring Your Future in Math and Science
http://www.cs.wisc.edu/~karavan/afl/home.html

Information about scientific and technological fields and links to other resources. Designed for high school girls.

The Faces of Science: African Americans in the Sciences
Louisiana State University Libraries
http://www.lib.lsu.edu/lib/chem/display/faces.html

Profiles of African Americans in the sciences; bibliographies and other resources.

Girls Incorporated
http://www.girlsinc.org/

Highlights include an update of research on critical issues facing girls, tips for parents and teachers, and a Re-Cast TV Action Kit that helps students confront stereotypes in the media.

Idaho on the Net
http://www.micron.net/weblnch/idaho/idaho.html

Idaho Web sites including education, government, and community organizations.

InGear: Integrating Gender Equity and Reform
http://www.ceismc.gatech.edu/ingear.htm

The Toolkit of Curriculum Materials includes resources for parents, teachers, and counselors; links to equity Web sites and information on teaching strategies.

Lathrop Alaska Native Education Program
http://www2.northstar.k12.ak.us/schools/lth/organizations/ane/ane_homepage.html

ANE develops culturally relevant curriculum materials for teachers in the Fairbanks North Star Borough, and provides Home School Liaisons for schools with the highest percentages of Native American and Alaska Native students. The Web site provides information on Inupiaq, Athabascan, Tlingit, Sioux, Mohawk, and other Native cultures.

National Network of Eisenhower Consortia and Eisenhower National Clearinghouse
Equity Task Force
http://ra.terc.edu/nnercc/nnercc.html

Materials, professional development resources, discussion groups, and equity resources concerning women, persons of color, and persons with disabilities.

Wisconsin Center for Education Research
National Center for Improving Student Learning and Achievement in Mathematics and Science
http://www.wcer.wisc.edu/

Focuses on the needs of students from diverse cultural backgrounds. WCER provides training and technical assistance.

Northwest Educational Technology Consortium
http://www.netc.org/

Professional development and technical assistance for educators who want to become informed and fearless users of technology. Site includes information on equity in educational technology, with assessment and planning tools.

North Central Regional Educational Laboratory
Pathways to School Improvement
http://www.ncrel.org/sdrs/pathwayg.htm

Overview of issues and strategies for educational reform. In the Math and Science sections, see Ensuring Equity and Excellence in Mathematics and Ensuring Equity and Excellence in Science.

Tap Junior
http://www.cs.yale.edu/homes/tap/tap-junior.html

Resources for encouraging girls in science, computers, and technology.

Women of NASA
http://quest.arc.nasa.gov/women/intro.html

Live WebChats, biographies of women working at NASA, and online and print resources for teachers, including mathematics and science activities.

Equity Resource Center, WEEA Equity Online
http://www.edc.org/CEEC/WEEA/

Provides information, gender-fair multicultural materials, technical assistance and training, and moderates an Educational Equity Discussion List.

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